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ABSTRACT

Children aged 2, 6, and 9 years old were presented with four sets of differing objects and were asked to tell the experimenter which object out of each set they liked best. It was discovered that, as children grow older, pointing becomes rarer and linguistic descriptions become more appropriate. In two further experiments, the distance between subject and object and between the objects themselves was varied. The children pointed most often when it could be used as a referential means alone, and least often when it had no referential function at all. In a final experiment, objects were introduced for which the children had no verbal labels. Nearly all the children used pointing. The data indicate a continuum between the exclusive application and appropriateness of pointing and the exclusive application and appropriateness of verbal reference; between these two extremes pointing and verbal reference are combined in a characteristic pattern. This suggests that earlier acquired forms of nonverbal referential behavior do not disappear with the acquisition of language but remain in the behavioral repertoire and serve specialized functions. (JB)

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FROM GESTURE TO WORD AND GESTURE

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One of the most basic functions of communication is reference. From a psychological viewpoint, reference can be defined as an action, verbal or nonverbal, by which one person tries to focus the attention of another person on a certain part of the environment. It is important to note that such an action consists of two sub-processes: directing and attracting attention. To direct another person's attention presupposes that his or her attention has already been attracted.

There are several means for attention-attracting and attention-directing. These cover all five senses and are not exclusively related to one of the two sub-processes. However, acoustic and visual means seem to be dominant. In the following we want to outline differential efficiencies and developmental changes of three visual and acoustic means of reference that are basic, namely direction of gaze, pointing, and verbal utterances.

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In the development of the infant the first available means for attracting another person's attention are the child's sounds and body movements. However, these initially rather unspecific forms of behavior have mainly an expressive function. As a referential device they are of very limited value since they can direct someone's attention only to the child himself and his needs or feelings without many possibilities for further specification.

Children are able to direct another person's attention to something or someone different from themselves when they have reached a stage of development that allows them to touch and grasp a single object or person. However, these achievements still have their obvious limita-

tions with regard to reference. First, they are restricted to the child's immediate surroundings. Second, it is difficult for the other person to decide whether the child uses grasping and touching as a referential means, or whether this activity only indicates exploratory behavior or play.

To refer to more remote parts of the surroundings the child must have learned either to move and to combine his locomotion with touching and grasping, or to indicate directions. The ability to indicate directions seems to be a significant new part of the child's ability to differentiate communicatively between himself and the present environment.

The ontogenetically first form of behavior which, in principle, can serve this function of indicating directions and thereby referring to more remote objects and persons is gaze. Collis & Schaffer (1975) reported some evidence that the young child's direction of gaze is indeed used as a means of reference, at least on the side of the addressee. According to their study mothers usually follow the baby's direction of gaze. Moreover, by manipulating and often labeling those objects the child looks at, mothers probably reinforce the further development of referential abilities. A complementary issue was studied by Scaife & Bruner (1975). They showed that as children get older, they follow the mother's line of regard more frequently. Three month olds followed the mother's eye gaze 30% of the time, one year olds all of the time.

Nevertheless, direction of gaze is still of very limited value. There are a number of problems associated with assuming that direction of gaze is used as a referential device by very young children. One problem is in determining whether gaze is intended as communicative behavior, since it is of course not exclusively used for this purpose. On the basis of gaze alone the other person cannot infer what function it fulfills at any particular time. Another problem concerns the precision with which the child can indicate what he means. Gaze can define only a vector and the greater the distance between the two people, the more difficult it is for the addressee to recognize the other person's direction of gaze.

These two problems are less important when the child starts using his extended arm and finger. First, the pointing gesture now clearly functions as a conventionalized symbol that can easily be differentiated from other forms of behavior. Second, the spatial restrictions are less severe on pointing than for gaze, since pointing allows reference to objects that are farther away and it allows a greater precision for indicating what is meant. One further advantage is that pointing, as the term implies, not only defines a vector but can also specify a particular point. However, even pointing has clear limitations, and we shall mention three of them.

First, a pointing gesture does not sufficiently specify what it actually refers to. Pointing at an object can refer to the object as such, to its color, to its function, or to many other things. Relying on the gesture alone cannot differentiate between these possibilities. Second, pointing, like the child's gaze, only functions if the addressee is already paying visual attention to the person who is

pointing. At least the pointing person must be in the addressee's field of vision. Third, pointing is still a deictic means of reference and as such it is more or less restricted to the here-and-now of the actual situation.

All problems of reference, perhaps except for those in philosophical discussions about reference, can finally be solved, in principle, when language has been acquired. In using language appropriately, verbal expressions can be understood by the hearer without any dependence on contextual aids in the management of joint reference. Thus spatial restrictions are less critical since now the speaker can be outside of the addressee's field of vision. The speaker can also make a clear distinction between reference to an object or to specific features of this object when the appropriate linguistic expressions are available.

It seems as though, in principle, language can take over all functions that gaze and pointing can serve with regard to reference. Linguistic devices, as the most versatile ones, seem to make other forms superfluous. And indeed, the few studies dealing with the order of acquisition of referential means have almost exclusively been interested only in gaze and pointing as precursors of linguistic forms of reference (Clark, 1978; Murphy & Messer, 1977).

This emphasis could reflect a quasi - Darwinian position. Namely that the less flexible and less precise devices are gradually superceded by more flexible and more precise ones. There are three possible interpretations of this position. First, the more flexible and effective devices take over the function of the others, which then disappear. Second, earlier forms are used in addition and in redundant combination with later ones. Third, the earlier forms remain in the behavioral repertoire and serve specialized functions in certain situations.

One of the principle aims of our experimental work that we will describe below was to collect evidence to support one or the other of these interpretations. Our experimental studies cannot definitively decide among the three theoretical possibilities we just mentioned, but they do provide some clear support for the third position.

In our first experiment on 2, 6, and 9 year old children, ten subjects of each age and 20 adults were presented with four sets of objects that differed in class membership, color, and size. The subjects were simply asked to tell the experimenter which object out of each set they liked best. The distance between subjects as speaker and the objects, and the distance between the objects themselves were chosen in such a way that the experimenter as hearer could not identify a single object by a speaker's pointing gesture alone. Here, pointing was not a functional means for referring.

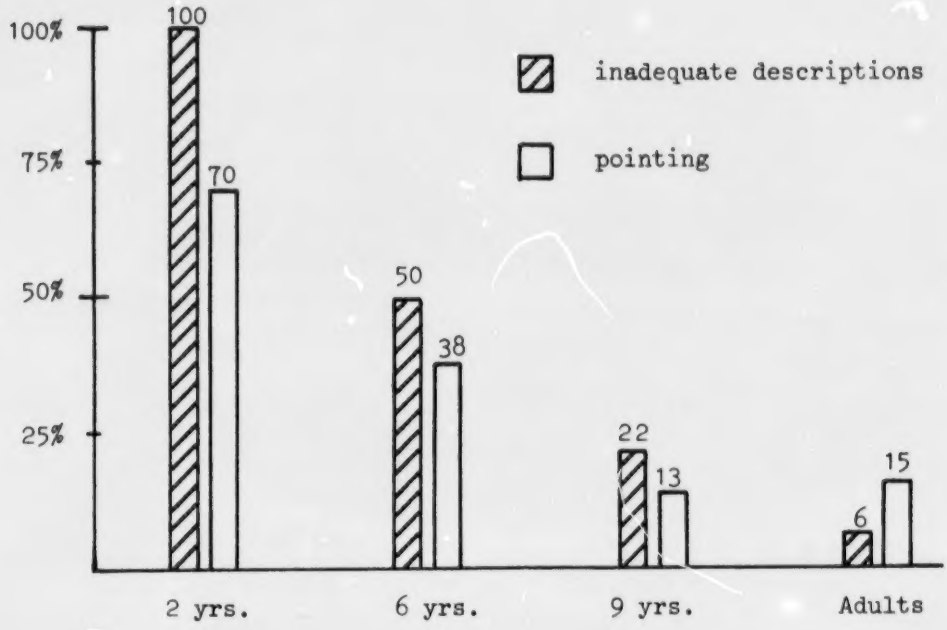

Figure 1. Percentage of pointing and of inadequate verbal descriptions when pointing served no referential function

The results presented in Figure 1 indicate strong age effects for the frequency of pointing as well as for the adequacy of linguistic descriptions. All age differences are statistically significant at least at the $p < .03$ level (chi-square tests) except the nonsignificant difference in the frequency of pointing between the 9 year olds and the adults.

As children get older, pointing becomes rarer and the linguistic descriptions become more appropriate. The second effect has, of course, been described by many researchers in the field of referential communication and is not surprising at all. The first effect means that pointing, whenever it is entirely redundant, is less frequently used as children get older and their linguistic abilities improve. However, it remains an open question as to whether younger children cannot assess the spatial restrictions of pointing appropriately or whether they resort to earlier forms of reference when later acquired ones do not function adequately. The latter possibility seems to be more likely.

That even younger children do take into account the spatial restrictions of pointing under different conditions can be shown by the results of our second and third experiment. In these two experiments we varied the distances both between the child as speaker and the objects and between the objects themselves. In one condition (A), the objects were in reach of the children and pointing alone could

identify a single object for the hearer. In a second condition (B), the objects were farther away, but by pointing, the children could exclude half of the contextual alternatives because the objects lay in two clearly separated groups. In a third condition (C), the objects were far away from the child and lay close to each other as in Experiment I so that pointing could not serve a referential function.

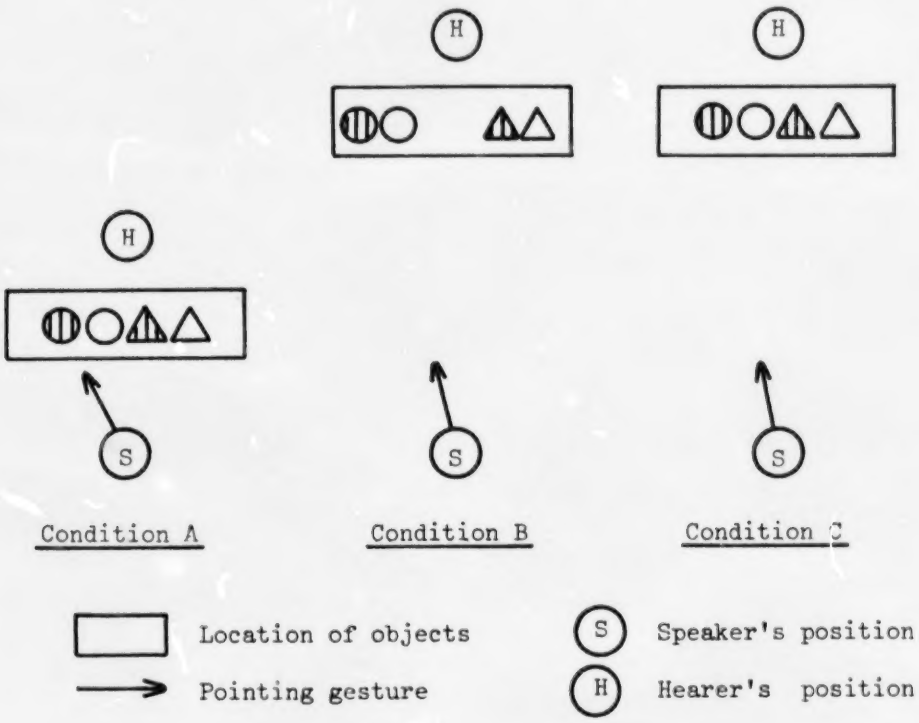

Figure 2. Spatial arrangements of Experiments II and III

Experiment II included conditions A and C, Experiment III included conditions B and C. Subjects in Experiment II were 4 three year-olds, 7 four year-olds, 9 five year-olds, and 5 six year-olds. In Experiment III there were 4 four year-olds and 15 five year-olds.
Pooling the data from the four and five year-olds in Experiments II and III, our results clearly indicate that children of this age take into account how functional pointing is under different spatial conditions.

Table 1. Proportion of pointing under different spatial conditions in Experiments II and III

Conditions		
A	B	C
.67	.37	.13

All differences among the conditions are statistically significant at least at the $p < .03$ level (chi-square tests). The children pointed most often when it could be used as a referential means alone, and least often when it had no referential function at all. Therefore, we may tentatively conclude that as children get older, pointing is less often used redundantly. If pointing is used by young children when it does not serve a referential function, this is not because they think it is appropriate, but rather because they lack the necessary linguistic abilities and therefore regress to earlier means which are not appropriate in the particular situation.

The results so far support the claim that language becomes the primary referential means with increasing age, and they show that at the same time pointing decreases but remains in the child's repertoire and is used again when linguistic means fail. We will now discuss some additional results of our experiments that substantiate our claim that earlier, nonverbal forms of referential behavior do not simply disappear with the later acquisition of more flexible ones, but remain in the behavioral repertoire and serve specialized functions.
First, we introduced a set of objects for which the children had no verbal labels. We put these objects in reach of them so that pointing was an appropriate referential device.

Table 2. Proportion of pointing when verbal labels were not available

1.0	.86	.86	.83
3 yrs.	4 yrs.	5 yrs.	6 yrs.

It turned out that nearly all the children used pointing, whereas

only very few tried to find some form of verbal description to differentiate the objects. It is obvious that adults too use pointing in situations where they suffer from word finding problems.

There seem to be other functions pointing can serve after the first years of childhood. One is that by pointing we can very quickly refer to a certain object in situations where a verbal description would have to be very extensive and time-consuming. This is for example the case when one has to select some object out of a larger set of very similar objects where it would only be possible to characterize the spatial position of the object in question.

This last function suggests a general question about the relationship of verbal and nonverbal forms of referential behavior, namely whether linguistic and gestural devices for reference are related to each other or whether they are planned and carried out more or less independently. Our experimental data support the first hypothesis: if objects were in reach of the children so that pointing alone was a sufficient referential device, and if the children used both pointing and language in this situation then their verbal description alone would most often have been not explicit enough to differentiate the target object from the context. This was true for 88% of all cases. In other words, by using pointing as an appropriate referential means, the children in our study were only very rarely simultaneously explicit enough in their verbal description. By pointing, they saved parts of their speech, so to speak, because when children did not point, their verbal descriptions were inadequate in only 19% of all cases. Therefore, our data suggest that, at least in children, the gestural and linguistic means for reference are planned and used in combination and not independently.

This claim is further supported by an analysis of the temporal relationship between pointing and the concurrent verbal references. First, there was a great temporal overlapping between the verbal and the nonverbal behavior. In only 8% of all cases did the pointing gesture and the verbal description not temporally overlap. Furthermore, the temporal succession of both referential means was very systematic: in 95% of the cases the onset of the pointing movement began before the utterance. And finally we found another systematic relation between pointing and speech: pointing occured mostly at the time the discriminating features in the verbal description were uttered. In 73% of all cases the children pointed while uttering the discriminating feature of their description. The corresponding proportion for non-discriminating parts of the verbal description was only 29%.

To sum up, we reported experimental evidence that language becomes the primary device for reference with increasing age. However, our data strongly suggest that earlier acquired forms of nonverbal referential behavior, such as pointing, do not simply disappear with the acquisition of language as the most versatile referential device but remain in the behavioral repertoire and serve specialized functions. Finally, our results go some way towards answering the question of

whether verbal and nonverbal behavior are closely related or whether they are more or less independently planned and carried out. Our data strongly support the first view - that is, there is a close relationship between the verbal and nonverbal behavior, at least during childhood. Pointing clearly affected the form of verbal descriptions. Furthermore, our analysis showed strong temporal relationships between pointing and the concurrent verbal behavior.

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NOTES

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